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than ordinary interest, as it may be that this comet is identical with DE VICO'S lost comet of 1844. In a recent issue of the *Mount Lowe Echo* he announces the discovery of another comet in *Ursa Major*, on December 16, but before it could be identified the Moon arose and obliterated it; the next two nights were cloudy, and on the following night a search failed to find it.

Upon the completion of the railway to the summit, the observatory is to be permanently located there, and it is the intention to add several instruments to the equipment. The most important addition is to be a 3-foot reflector, which is to be used chiefly for photographic work.

Dr. SWIFT is much pleased with the great number of clear nights which the Sierra Madre afford. In a recent letter he says that, from April 20 to December 1, the cloudy nights have scarcely averaged three per month.

Visitors are permitted to look through the telescope every night, we understand. Besides a post and telegraph office, Echo Mountain has its newspaper—the *Mount Lowe Echo*, Professor G. WHARTON JAMES, editor—to whom we are indebted for the illustrations of the observatory which are here presented.

The large search light from the Midwinter Fair has been purchased and mounted at Echo Mountain.

THE PROGRESS OF METEOROLOGY IN THE UNITED STATES.

By A. L. COLTON.

[ELEMENTARY METEOROLOGY. By W. M. DAVIS. Boston: GINN & Company. 1894.]

It is but very recently that meteorology, the youngest of the applied sciences, has gained any importance as a distinct subject to be taught in schools and colleges, although there is apparently no older topic than the weather. The long list of ridiculous "signs," upon which the weather-wise have based their predictions, still has a strong hold on the popular mind. A prime reason for the slow development of this science is the instability of the elements involved, and the corresponding difficulty of performing upon them definite experiments.

Almost from the invention of the barometer, two hundred and fifty years ago, occasional suggestions have been made by scientific men, looking to the systematic study of weather phenomena. In a few cities of the eastern states observations of temperature and precipitation were undertaken nearly a hundred and fifty years ago, and were continued with more or less regularity. During the first half of the present century a few papers were published on the movements of storms, notably by REDFIELD and ESPY, and though weather predictions, in the modern sense of the term, were not practicable, efforts were made for the establishment of a systematic weather service under governmental supervision. Through the personal efforts of a few officials in various branches of the Government, observations were made and to some extent digested. The Smithsonian Institution was especially efficient in this work, and gradually absorbed the observations carried on under other auspices, so that in 1870 it controlled nearly all the meteorological records of the country.

The invention of the telegraph rendered possible the forecasting of storms from simultaneous observations made in different places and communicated to one central station. Lieutenant M. F. MAURY was the first to recognize the great field of work thus opening, and during the "fifties" labored for the establishment by Congress of a central office from which reports might be telegraphed over the country, warning farmers of the approach of storms and frosts. Before he could succeed, however, the plan was lost from sight in the excitement of the civil war. In 1856 the Smithsonian Institution received simultaneous reports by wire, and for a time maintained a daily weather-map. At about the same time WILLIAM FERREL, a mathematician of great originality, began his studies on the effects of the Earth's rotation upon atmospheric currents; these studies, continued to later years, resulted in the first rational theory of the general circulation of the atmosphere.

In 1869 Professor CLEVELAND ABBE, then director of the observatory at Cincinnati, with the aid of the Chamber of Commerce of that city, issued the *Weather Bulletin of the Cincinnati Observatory*, containing daily weather forecasts, and continued this publication until January, 1871, when he was called to Washington to assist in the forecasting work of the Signal Corps.

Shortly before this time, by the exertions of several individuals, largely civilians, but including General MYER (Chief Signal Officer), Congress passed a resolution creating the Meteorological Bureau of the Signal Corps. This service went into effect November 1, 1870, and for more than twenty years maintained with excellent results a system of weather predictions for the United States. The work at length far overshadowed the original duties of the Corps, which related only to military signaling in the army. Toward the end of this period strong dissatisfaction had arisen both within and without the service, and efforts to have the meteorological work transferred from a military to a civil basis were at length successful. In 1891 the Weather Bureau of the Department of Agriculture was organized, and, upon taking charge of the meteorological service of its predecessor, improved it in various ways, with especial reference to the needs of the agricultural class.

Such is a brief summary of the history of meteorology in the United States. This history seems to be little understood, even yet, for individuals, and even newspapers, when referring to the weather predictions, often speak vaguely of the "Signal Service," and the "Signal Service Bureau," with as little regard for accuracy as those who use the word "cyclone" where "tornado" is meant.

Before the Signal Corps began its work of weather forecasting, the study of meteorology was confined to comparatively few persons, and chiefly to scientific men of some prominence. With the growth of the Signal Service more extensive instruction in meteorology became a necessity, and this was largely supplied to the new members of the Corps at Fort Meyer, Va. A few colleges gradually included courses in this science; but, as a whole, the work was feebly carried on. The instruction afforded by the Government, and lucrative positions as observers, were to be had only by joining the army for a term of years—something distasteful to the average civilian. With the establishment of the Weather Bureau, the observers who remained in the weather service lost their military standing, but were soon placed under civil service protection, and the force somewhat enlarged. At the same time a campaign of popular education was inaugurated, both to lead the public to a higher appreciation of the benefits of the weather service and coöperation in its work, and to advance the study of the science of meteorology in schools and colleges. Competent officials of the Bureau were encouraged to promote these objects by the delivery of public lectures and in other ways, and especially by furnishing schools with the daily weather-maps and leading the students to a knowledge of the more elementary laws of storms. This policy was justified by the hearty welcome with which the public received the newly-established Bureau, and the results have been highly satisfactory.

Under the military *régime* comparatively few college graduates sought positions in the weather service, though many found places in the State and national geological surveys, and in other public scientific work. Under the present system, the force of observers and other trained employees in the Weather Bureau must be recruited from the educated young men of the country, by competitive civil service examination. A new field has thus been opened to suitably prepared persons who have tastes in this direction.

Hitherto, no suitable American text-book of meteorology, sufficiently elementary and at the same time comprehensive and up to date, has been available for the use of students in high-schools and colleges, and for the constantly increasing class of general readers who are seeking the information that such a book might afford. LOOMIS' "Meteorology," once very useful in its way, is now far behind the present conditions and requirements of the science. FERREL'S works are highly mathematical, and even his "Popular Treatise on the Winds," a very excellent book, intended for more general reading, is too technical for the purpose mentioned. A few modern works of a popular nature have been published, but mostly specific in character and hardly filling the want of a general text-book. To these and to magazine articles the public has had to look for instruction. In schools the text-books of physics and physical geography afford some scattering information, and in colleges instruction in meteorology is largely given by means of lectures, and also, latterly, by laboratory work.

The work named at the head of this article, written by the professor of physical geography in HARVARD University, is our first text-book designed to fill the needs just mentioned, and as such marks an epoch in the progress of meteorological education. In the space of about 350 octavo pages Professor DAVIS has given, in very attractive form, a compendium of the science of meteorology as it exists to-day, omitting the mathematical processes only suitable for advanced students; he gives, however, many of their results. Upon reading the book and noting the sequence of the topics and the logical manner of their development, one readily sees that this is the work of an experienced teacher.

The titles of the fourteen chapters will convey an idea of the scope of the book: The general relations of the atmosphere; extent and arrangement of the atmosphere about the Earth; the control of atmospheric temperatures by the Sun; the colors of the sky; the measurement and distribution of atmospheric temperatures; the pressure and circulation of the atmosphere; a general classification of the winds; the moisture of the atmosphere; dew, frost, and clouds; cyclonic storms and winds; local storms; the causes and distribution of rainfall; weather; climate.

The author states that the greatest share of whatever is valuable in this book comes from his having studied and followed the work of FERREL; and the latter's theories of the motions of the atmosphere are simply and non-mathematically stated, and given a position of fundamental importance. It is expected that students who follow this book will have had preparation to the extent of the usual high-school course in physics. The fundamental principles needed are so clearly stated as scarcely to make even this preparation an absolute essential, though the scientific training and power of attention to be gained from such a course will be highly useful to the reader. The preface gives a list of books suitable for collateral reading, and some advice as to methods of teaching; suggestions are also given for original work.

Considerations of space will hardly permit extended notice of particular portions of the book. The chapter treating of the colors of the sky, the dust of the atmosphere, and various optical phenomena of the atmosphere, seems especially interesting. In the chapter on the distribution of atmospheric temperatures the influence of the ocean currents is dwelt upon at considerable length; the omission of a chart of these currents seems to be a little unfortunate. Of cloud observations the author says: "If the observer wishes to learn something of atmospheric processes for himself, he should give at least as much time to cloud observations as to all the other records together." Storms which cannot be clearly attributed to periodic changes of temperature are classified as cyclones, thunder-storms and tornadoes. Some attention is given to atmospheric electricity. The illustrations are numerous and well-executed. The principal meteorological instruments are described, with cuts, and in many cases information is given as to cost.

On page 96 the height of Mount Hamilton is given as 4,400 feet; the LICK Observatory, where meteorological observations are taken, is slightly more than 4,200 feet above sea-level. Other accidental errors have not been noticed; absolute freedom from such is hardly to be expected, especially in a first edition.

It may be mentioned, in conclusion, that the mechanical execution of the book is excellent in every way.

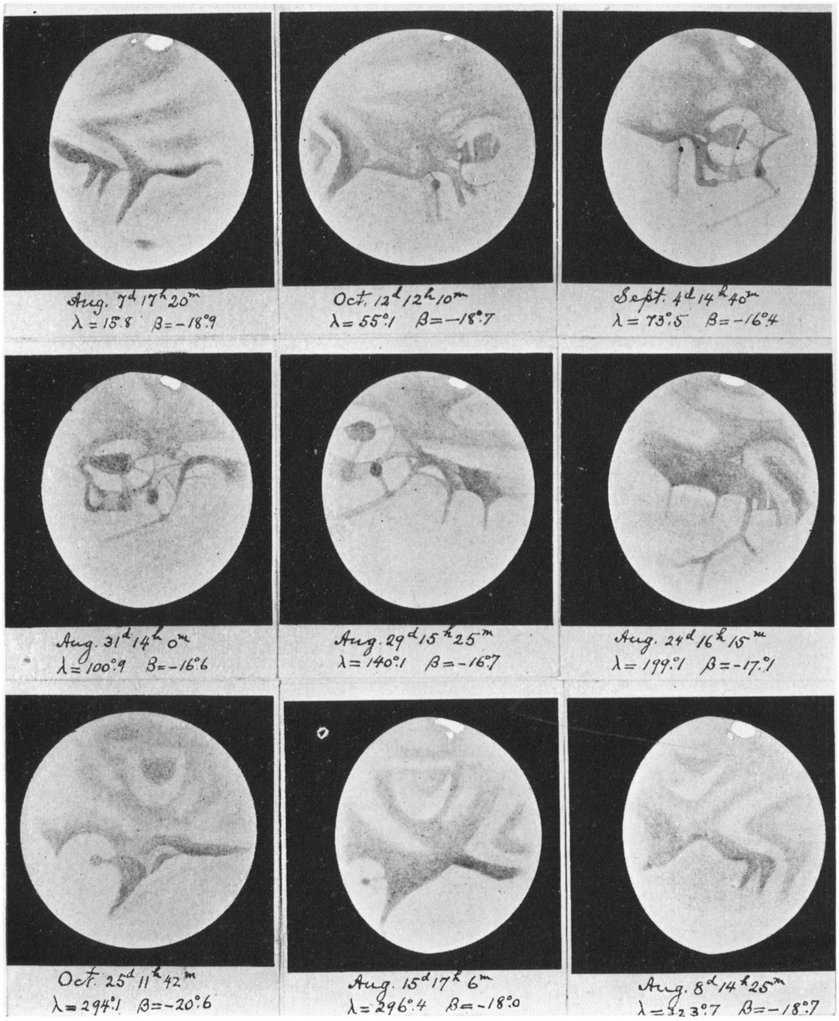
THE CLIMATE OF *MARS*.

By MARSDEN MANSON.

The fact that *Mars* presents phenomena which indicate milder polar climates than exist upon the Earth seems to puzzle many students of astronomy. Instead of endeavoring to account for these phenomena by logical deductions from admitted facts and known laws, some seem to find pleasure in exercising their ingenuity by ascribing remotely possible conditions, and then in accounting for these conditions by processes of argument which strain the faith of their co-workers beyond its limit of elasticity.

The writer will endeavor to show that the climatic conditions, generally admitted to exist upon *Mars*, can be explained without resorting to suppositions and hypotheses bordering near the limits of common sense. The arguments will be simple and fundamental. Until these simple explanations shall be shown to rest upon incorrect premises, or that wrong conclusions have been drawn, the scientific imagination should be restrained within reasonable bounds.

The mean distance of *Mars* from the Sun is about one and one-half times the mean distance of the Earth; and its volume is about one-seventh that of the Earth. Unlike the rest of the planets, its own and other satellites, *Mars* reflects a rich ruddy light—an important factor in interpreting climatic conditions. Upon equal areas the heat and light received by *Mars* is less than one-half that received by the Earth; it by no means follows that its climates are proportionately colder, for the actual amount of



Aug. 7^d 17^h 20^m $\lambda = 15^\circ.8$ $\beta = -18^\circ.9$

Oct. 12^d 12^h 10^m $\lambda = 55^\circ.1$ $\beta = -18^\circ.7$

Sept. 4^d 14^h 40^m $\lambda = 73^\circ.5$ $\beta = -16^\circ.4$

Aug. 31^d 14^h 0^m $\lambda = 100^\circ.9$ $\beta = -16^\circ.6$

Aug. 29^d 15^h 25^m $\lambda = 140^\circ.1$ $\beta = -16^\circ.7$

Aug. 24^d 16^h 15^m $\lambda = 199^\circ.1$ $\beta = -17^\circ.1$

Oct. 25^d 11^h 42^m $\lambda = 294^\circ.1$ $\beta = -20^\circ.6$

Aug. 15^d 17^h 6^m $\lambda = 296^\circ.4$ $\beta = -18^\circ.0$

Aug. 8^d 14^h 25^m $\lambda = 323^\circ.7$ $\beta = -18^\circ.7$

PLATE C$_3$

MARS, 1894.

By W. W. CAMPBELL, LICK Observatory.